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F+R Hugs: How to Communicate Physical and Emotional Closeness to a Distant Loved One?

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Concept authors: Francesca Rosella, Italy and Rikako Sakai, Japan

User test group: Graduate students, researchers and faculty at Interaction Ivrea in 2002
Project date and duration: March 2002, June 2002, 8 weeks, and ongoing January-April 2004
F+R Hugs was designed in March-April 2002 and various successive iterations in May and June of the same year in cooperation with Rikako Sakai.

The paper and prototype presented have been developed in cooperation with Ryan Genz.

Abstract
F+R Hugs is a system that allows people to feel the physical closeness of a distant loved one, bringing the pleasant sensation of a real hug to body and mind. It has been designed to satisfy a desire shared by many people: communicate emotions to the distant person we love in a tangible way. F+R Hugs was designed through intensive participatory design sessions, questionnaire, interviews, iterative prototyping and body storming with users, studying people behavior and emotions. It is an input and output device that checks and controls various sensors and actuators through a microprocessor. The sporty shirt receives the input of heart beat, touch and body temperature of the remote loved one, and represents this as output recreating the physical pressure of a hug through inflation and deflation of cushions embedded in the shirt. It works through a mobile phone network and can be activated by SMS messages.

Future applications will be multiple, telecommunication companies can adopt it as mobile communication device, people always on the move will feel the touch of their relatives, children in intensive care will feel the closeness of their parents, fans will be touched by their favorite artist during a concert, many possibilities are imaginable.

Keywords: Wearable Computing, Emotion, Telecommunication, Haptics, Tele-presence, fashion design, designing desire, User Centered Design, User Testing.

Introduction

F+R Hugs was the result of the 4 weeks design workshop Designing Desire. The brief was that of designing a product which should be: emotionally desirable, technologically feasible and to be worn on the body.

What is the value of combining emotion and technology?

Technology occurs in most of our daily activities, is defines the way we relate to others, and becomes part of who we are and how we act. Technology is often adopted for utilitarian and practical reasons but turns out to be impractical to use because it is complex without being useful. Many of the computer operating systems, (especially Windows) are designed without

any quality and emotion. Humans are made of emotions and it is necessary to construct technology in order to fulfill our emotional needs and express the communicative function of emotion. Interfaces and systems must be intuitive, natural, and compatible with our emotional status. Combining emotion and technology should be part of every design process.

Motivation

The project was conducted in the multicultural environment of Interaction Ivrea, a newly formed Interaction Design Institute in Northern Italy. Rikako and I belong to the first class of graduating Master's students in 2003. The project took place in the first year of our two years experience in Ivrea. On October 1st 2001, 20 students and about 20 faculty members landed in Ivrea from Japan, India, Sweden, Denmark, United Kingdom, United States of America, Italy, Russia, Germany, Austria, Venezuela, Croatia, Slovenia, for the starting of the very first year of the Institute's programme.

After the first three months in Ivrea both students and faculty became aware of the distance put between them and their families, friends, and loved ones in their home countries.

Background: Exploring desire

When the Designing Desire workshop started Rikako and I teamed together and started to think about desirability and which things humans desire the most. Rikako missed her family and boyfriend. The thing she missed the most was hugging him, I missed my friends and especially the five minutes hug with best buddies Luca and Emanuela every time I see them.

We decided to ask our colleagues the things they missed the most from their previous lives back home, and if a wish could come true, what they would ask for. They seriously needed a hug, and F+R Hugs project was started.

Why hugs are good for you?

During the first phase of the Designing Desire workshop we worked on searching and defining desirability, from extremely precious objects to private emotions. After several interviews and case studies we started to ask our users to define the hug and why it was important for them.

From infanthood, hugging represents the concept of protection for our body and protection for our feelings. When a child is crying, her mother hugs her and the infant is reassured and calm. Research evidences that the absence of physical contact in the first part of a child's life or elderly people's everyday loneliness can lead to depression and death.

The aim of F+R Hugs is that of let users feel the touch, the warmth and the pleasure of this hug. It allows the user to feel a loved one's heart beat, strength and tenderness on her/his body. F+R Hugs represents a new generation of clothing that cocoons the user's body and emotion at the same time. F+R Hugs will demonstrate how it is possible to share real time emotions, over distance, both in a mental and physical way with our loved ones in distant places.

Taxonomy of hugs

Applying a user centered design approach and involving users in participatory design sessions and interviews we defined several categories of hugging. They go from simple greetings to tough friendship holds, from sharing happiness for a success, or a sport performance to tender parental love, from condolatory to cherish, and true love. Often traditional holdings are better than the brand-new ones, that's because you are more familiar with them, or for long term relationships, far from the first awkward hugs shared with the same person. In order to apply new holdings, you need practice.

Psychological effects of hugging on other senses

Hugging affects all of our five senses. Due to the large amount of skin contact, and parts of body surface shared with the other, hugs stimulate the production of endorphins. Often we don't think about our skin as the largest organ we own, but our skin receptors stimulate other chain chemical reactions that accentuate the senses' responses to this same stimulus. In other words: hugging makes you happy!

During a hug, close to our ears, the mouth of our loved ones whispers sweet words. Hearing is rich in feeling and emotion. The sound and modulation of a loved one's voice creates feelings of comfort and joy. Our closeness with the other makes us see details of him or her. Seeing is believing. Human facial expression and body mimics communicate a wide range of meaning and convey a deeper emotion.

Humans need physical contact with each other. An infant may sink into depression and die without the closeness of her mother's body. Adults deprived of tactile contact for a long period of time will tell you just how depressing it feels. A hug, a handshake, a pat on the back, and a kiss are all very important. Scent of perfume, hair, clothes and skin of a loved one brings us closer to others. Smell and taste are primary ways an infant connects to his mother. The smelling of a particular scent could bring powerful emotional reactions while tasting reconnects to our memories and accentuates our present perceptions.

Why should a computer hug you?

An increasing mobility of humans throughout the globe, due to business or study reasons, has brought family members to spend most of their time apart from each other. All of our senses and our identity are affected by this situation. We now have a great variety of computing devices to fill our pragmatic needs– but there is a gaping lack of solutions provided for the more fundamental emotional needs. There is an increasing need of human contact that finally can be fulfilled through F+R Hugs.

Design

F+R Hugs was designed through a user centered design approach, participatory design and user testing, which led to several iterations of both concept and prototype, in order to refine the product and to provide users with a desirable and emotionally fulfilling experience.

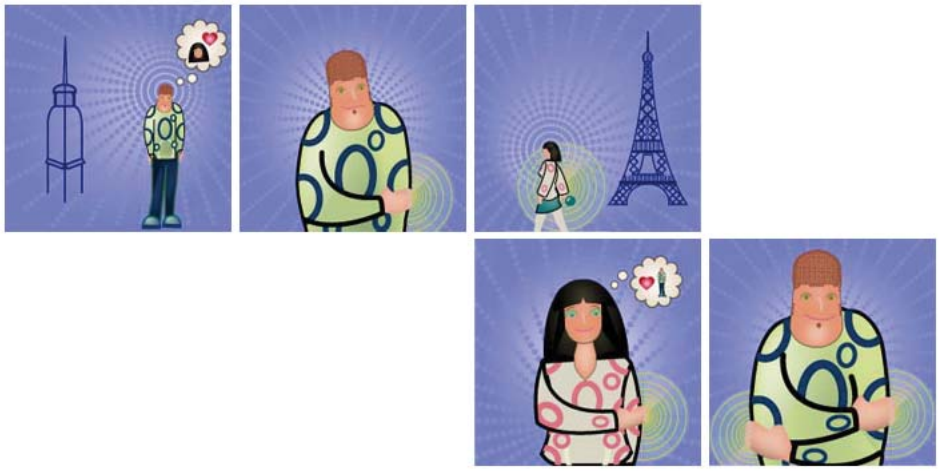

Figure 1, Use scenario: Bill and Karen exchange a hug over distance.

Scenario

Karen and Bill belong to the millions of people that are geographically separated from their loved ones. Bill is at home in Turin. Karen, his girlfriend, left a few days earlier for a meeting in Paris. It is a national holiday in Italy and he decides to go out and visit one of the beautiful museums in town. It is very cloudy outside. He wears the F+R Hugs shirt that is very comfortable in gloomy days. Exiting the Museum of Cinema he cannot stop thinking about Karen, he misses her very much, the movies from the fifties are her favorites, the hug scene between Humphrey Bogart and Lauren Bacall reminded him of their last meeting, he decides to send her a strong passionate hug (Fig. 1). After a few seconds Karen, running under the rain in Paris, late for a last meeting, receives Bill's hug. This is what she was really in need for: how lovely! All the pressure and fatigue of the day fades away in a glimpse. She sends him a hug back, a sweet, intense and strong love hug, Bill in Turin could feel her heartbeat and touch and warmth: this is like having her there!

Participatory design

We involved the final users in a participatory design practice from the early stages of the design process. This technique is very valuable and not widely used yet, it allows for faster refining of concepts and prototypes and this gives the possibility to bring desirable products to market in a shorter time and with better results. We often see products on store shelves that nobody will ever use; it is a waste of resources, contributes to pollute the environment and in the few cases in which customers buy them, it procures them headaches.

Questionnaire and interviews

In order to explore and understand the perceived value about emotional and physiological reactions to hugging, we asked users to hug a friend or a relative for no less than 30 minutes and report the experience in as much details as possible. After the hugging session we interviewed the users, compiled the answers in design parameters and built a first prototype following these primary guidelines. This gave the users the possibility to experience the prototypes earlier and the designers to reiterate on several details. After the first test we conducted new interviews that helped refine and craft the hugging experience. The keywords about emotional and physiological reactions to hugs have been used as parameters to develop aspects and features of the final prototype. The red circles visible on the prototype shirt pattern represent the position of the user’s hands in the different kind of hugging position

(Fig. 2). The circles are designed to contain the hug actuators and their size fits different users.

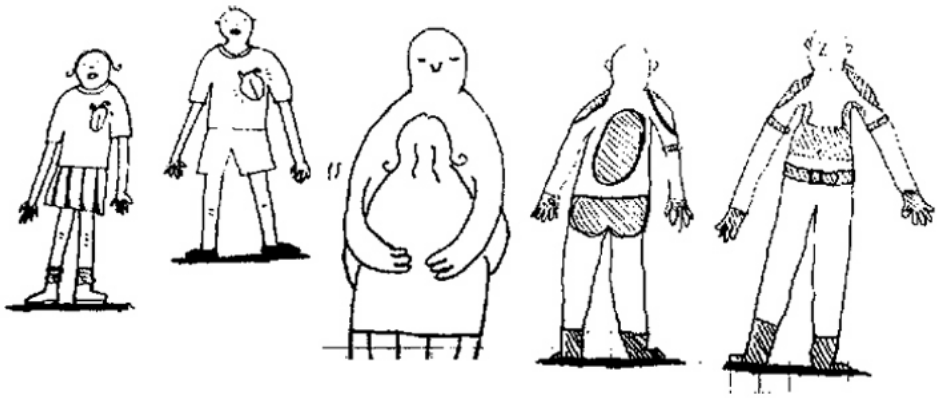

Figure 2, Participatory design: hug gestures and body parts involved.

Bodystorming

Brainstorming is a concept very well known: people together share ideas about a project, where to go for dinner or cinema etc. Bodystorming is this very same activity done by wearing a prototype of some wearable device and telling to designers how does it feel, why it is annoying or pleasant, and how could it be better, sometimes physically altering the disposable prototype. Bodystorming for F+R Hugs shirts was done at every stage of the design process. Users tried at first different kind of fabric and materials wearing them on their body, inside their clothes or outside existing ones, some slept with soft furry sponges, other have been squeezing tiny cushions for hours, others explored the oddity of inflating balloons under their shirts and others liked it. The images in Fig. 3 show users and prototypes during a Bodystorming session.

Figure 3, Bodystorming with prototypes.

Findings

From the interviews we divided the hug keywords in three categories: emotional, psychological and a list of the body parts involved. The interview answers can be read online at: http://www.identityservice.biz/hugsvideo.html.

Users reported that during a hug they feel real live energy, lovely and happy safety sensation, they perceive passion, pleasure and feel unstressed, relieved. The users report a sensation of acceptance and especially feeling desired by others and perceive through the physical contact that somebody likes them. Soft hugs come from people that take care of us: mothers, sisters, fathers, grandparents, and friends. On the emotional level a hug makes us perceive the soul of the other person.

The hug closeness contributes a sensation of warmth and relaxed harmony. During the hug positive natural chemicals such as endorphins get released within our body, our blood pressure regularizes, euphoria erases any distress. Rhythmic hugs to let a child fall asleep produce soft vibrations that resonate and calm. During the hugging sessions we mapped the position of participants' hands on the other's body. Major intensity points were identified on upper arms, on the upper back part during a condolatory hug, around the waistline, neck, shoulders, and hips. In these strategic spots we placed our technological sandwiches containing the hugging output actuators.

Fashion research

F+R Hugs is not only an Interaction Design project, based on innovative technology; it is also a fashion design project where form suits function. A broader diffusion of wearable devices should substitute the aggressive and uncomfortable feel of cyber or borg suits with richer emotional and aesthetics paradigms. People are not willing to wear computers for the sake of checking e-mails from their forearm; people are willing to use this very same technology to interact in a more human and intimate way with other humans.

Fabric and materials

To create the right hug, that naturally fits one's skin, soft and elastic materials have been investigated. More than natural fibers, synthetic fibers have developed a higher wearability and performance. The Lycra (Fig. 4) family by Dupont seemed to suit our purpose. These

materials make people feel cuddled, during the test they have been applied to parts of human body more sensitive to subtle warmth and pressure, and retained warmth from heating pads and released pressure by inflated cushions in a natural way.

Figure 4, Fabric and materials research: analyzing Lycra properties.

The garment

F+R Hugs first prototype was in the form of and underwear vest (Fig. 5), during a second iteration we developed a sport jacket.

F+R Hugs refers to the category of embracing clothes, glamorous patterns inspired by Japanese graphic design and innovative materials. F+R Hugs presents the same wearability and comfort of extreme sports clothing, it is easy to wash, to remove electronic padding, and is lightweight. Differently from previous wearable examples we designed F+R Hugs to be something so beautiful and comfortable that you can't notice you're wearing it, or that you're wearing technology.

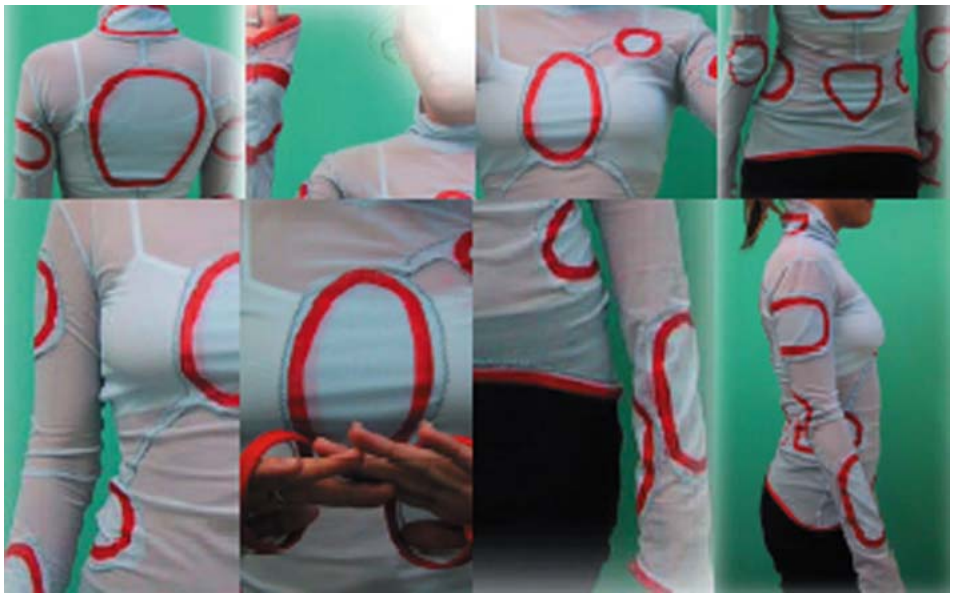

Figure 5, First prototype in the form of an underwear vest.

Technology research: other examples of wearables and what they miss

The research in wearable computing done until now presents very interesting examples. Some of them represent impressive innovation in the technological area but many lack magic and emotion. Technology can still make people dream, to do so it must be subtle and elegant. It is not the technological prowess that makes the right wearable, but the context where it could be used and why it should be used that enriches its function.

One of the earliest examples of wearable computer, the Wearable Mother Board (Jayaraman, 1997), was initially developed for military use, the research sponsored by DARPA of the US Department of Defense. It is a thin vest with an array of conductive fabric that allows locating a bullet wound on a soldier's body. It also transmits the soldier's vital signs to the central command and requests help when needed. Eventually, a sensor to detect oxygen levels or hazardous gases can be integrated into a variation called Smart Shirt that will be used by firefighters or worn by infants to detect Sudden Infant Death Syndrome. The Smart Shirt (Sensatex, 2004) allows to sense bio data from the wearer such as heart rate, body temperature, respiration rate, etc. Sensatex technology allows monitoring, sensing and information devices to be woven together into a fabric.

Similar to the Smart Shirt is the Life Shirt (Grossman, 2003) developed by Vivo Metrics Inc. a lightweight vest with body monitoring embedded sensors. It is used in clinical trials and

monitors patient's pulmonary, cardiac, and other physiological data, correlating them over time with the patient's diary of daily activities for a better diagnosis.

More recently and in a leisure oriented design approach, Motorola, in cooperation with Frog Design, developed prototypes of a set of wearable Bluetooth telecommunication devices called the Offspring. Each device, a pair of sunglasses, ear headsets, digital cameras, and wristband, can communicate wirelessly to the others in its family and transfer data through Motorola's iDen network. The result of another co-operation, this time between Philips and Levi's, was the MP3 Jacket. The jacket contains an MP3 player that can be controlled through the buttons embedded into the right front pocket. In New Nomads (Eves *et al*. 2000), a collection of garments with embedded technology, Philips explores the relationships and possibilities offered by textile technology, conductive fibers, and ambient intelligence.

All of the above projects represent interesting medical and military technological developments that are being implemented on a consumer level in the F+R Hugs project.

Design overview

The F+R Hugs bodysuit looks like a sport garment, it is a white Lycra T-shirt, with silk screen printed red circles (Fig. 6) and turquoise blue contrast stitching. Under the red circles are pockets containing the output devices connected between them thanks to small wires that run in the channels defined by the turquoise stitching. The output devices are inflatable technological sandwiches (Fig. 7), with an embedded speaker, a heating pad, and a tiny rolling pump. The pockets are placed on the back, neck, arms, waist and wrists. That makes the Hugs system completely modular, customizable and controllable by users. On the wrist and shoulders are positioned the pressure sensors making possible to activate the input and the system through natural gestures.

Figure 6, The F+R Hugs shirt, front, back view, and pattern detail.

The project

F+R Hugs is designed to have a transparent interface. The Input and output device check and control various sensors through a microprocessor (Fig. 7). The system works on mobile phone networks and can be activated by SMS messages containing the word Hug. In that way hugs can be exchanged also between a person that is not wearing the system and the one that wears it (Fig.9). The F+R Hugs shirt is a Bluetooth accessory for the user's mobile phone (Fig.10).

When receiving or sending a Hug the garment glows subtly (Fig. 8). Soft light communicates a sense of intimacy and emotion. The glowing is not visible in the daylight or in spaces with standard lighting condition, such as offices and museums, while in darkness it is perceived very subtly. F+R Hugs glowing can be activated or deactivated, to communicate or hide a private moment from onlookers.

The system

F+R Hugs is a flexible system: the output electronic sandwiches are placed inside special pockets that can be attached easily into garments. When removing the pockets the garment can be washed easily or worn without components. F+R Hugs is a modular system that allows the users to customize their hugs: adding more or less output devices the hug could be perceived full body or localized.

Figure 7, The Hugs system and a detail of the soft inflatable technological sandwich.

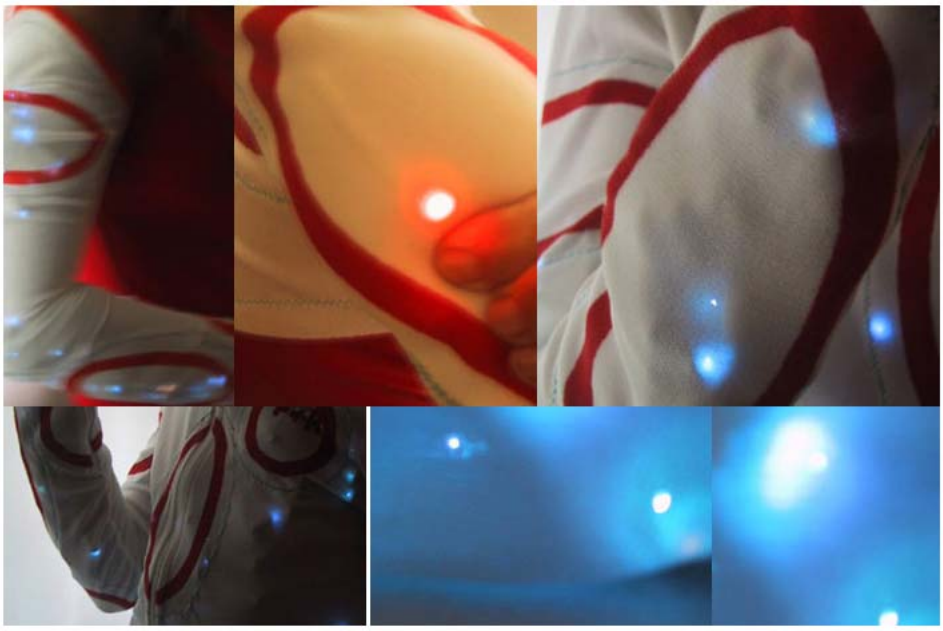

Figure 8, The F+R Hugs shirt glows when receiving a hug.

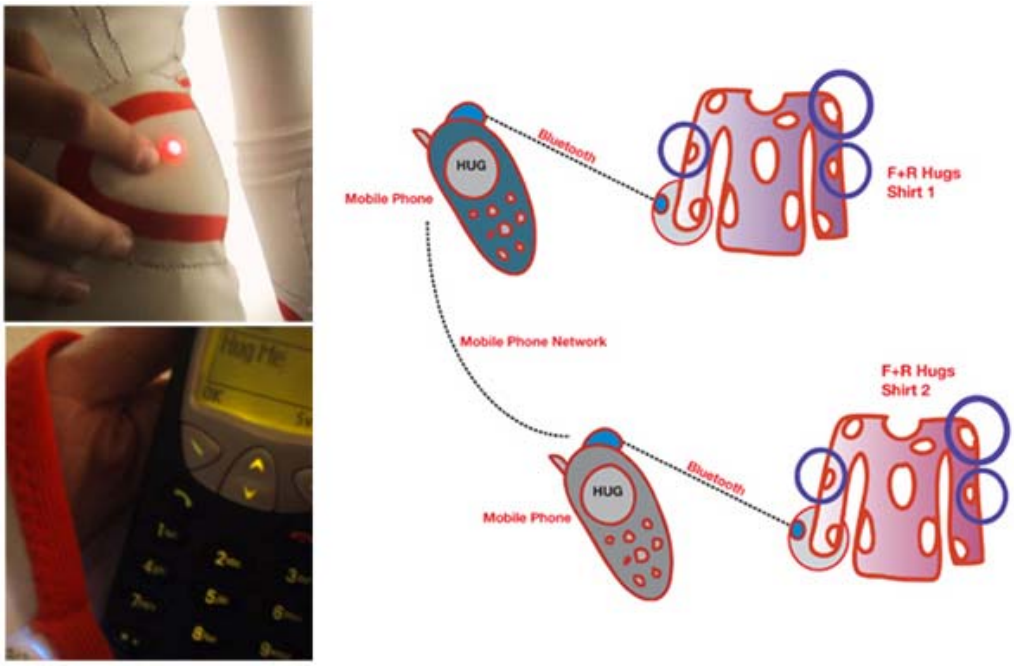

Figure 9, A Hug is sent through a mobile phone via SMS.

Input and output

When sending a hug the user touches the pressure sensors located in the F+R Hugs shirt, activating the heart beat sensor, temperature sensor, and the pressure sensor itself, that check her heart beat, skin temperature and strength of the hug. The data reaches the CPU and is then transmitted over the cellular network to the recipient mobile phone. In the recipient shirt the same type of CPU is connected to actuators. The actuators convert the data into output that recreates the hug's warmth, heart beat sound and pressure through a heating pad which warms up at the sender skin temperature, a rolling pump that inflates a soft pad which makes pressure on the skin, and a speaker that reproduces the vibration and sound of heart beat close to her skin.

The components of this input and output device are: CPU, thermistor, heart beat rate sensor (oximeter sensor), switch, LEDs, squeezable soft control with pressure sensor (FSR) in it, rolling pump, silicon balloons, heating pads, flat paper speakers (Fig. 10). The input/output device looks like a thin technological sandwich which is modular and could be connected in a series to create total body hugs or used just in two or three modules to create a soft hug around someone's shoulders. The modularity of the system makes it affordable to produce in

a variety of configurations, and makes it also easy to remove from clothing for cleaning or storage. The F+R Hugs system works on a small 12 Volts battery.

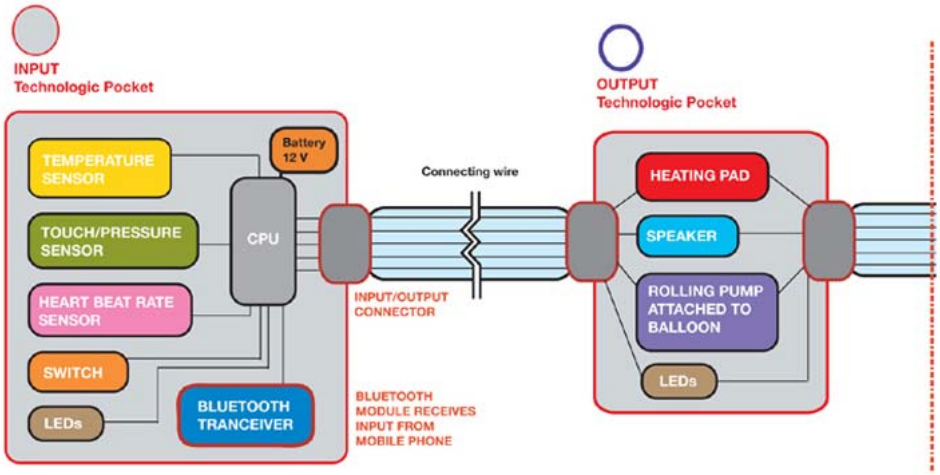

Figure 10, The electronic components of the F+R Hugs system.

Conclusion, results and next steps

The prototype we present in 2004 is an improvement of the 2002 prototype, the element added is that of modularity of output packages and the conductive links have been replaced with more robust ones. We hope to bring the project to the production stage in the next year through Cute Circuit Corporation. We need the cooperation of mobile communication providers and technology centers and we are seeking partnerships.

A new paradigm in desire and emotion

The F+R Hugs case study shows how design research benefits from a multidisciplinary approach to create products in which technology is subtle, almost invisible, to allow users to perceive the quality of their experiences. In designing F+R Hugs we adopted technology mainly used in medical or military field and adapted it aesthetically to the consumer market and functionally to fulfill the emotional needs of users.

A new paradigm in Telepresence

Until now receiving or transmitting a sensation of physical contact over distance has been exclusively for the use of medical research, or manufacturing industry, specifically in surgeons' training or in experimenting in microsurgery operations remotely controlled by

humans. In this project sophisticated haptic technology (from the Greek word haptaikos– sense of touch) is brought to a larger audience.

A new paradigm in mobile technology

Future applications will be multiple, telecommunication companies can adopt it as the latest mobile communication device, people always on the move will feel the sweet touch of their relatives, children in intensive care will feel the closeness of their parents, fans will be touched by their favorite artist during a concert or art installation, the possibilities are endless.

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Credits

Scenario graphic design by Jeffrey Tyson

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Francesca Rosella is an expert in wearable technologies. Her projects are being presented at lectures and conferences in Japan, Canada, Spain, UK, US, Denmark, and Salone del Mobile in Milan. With Ryan Genz she co-founded Cute Circuit Corporation, specializing in wearable technologies, art installations, interactive learning, and workshops in Interaction Design methodology. Cute Circuit's developed projects for Sony, Hitachi, Telecom Italia, and is currently collaborating with Trefoil Corporation and MIT Professor Seymour Papert, on an interaction design project for children's education. In April 2004 she received the CIBERART Award 2004 for Best Artistic Project.

Project note
F+R Hugs has been presented by: Gillian Crampton Smith from Interaction Design Institute Ivrea at NTT Docomo NTT ICC (Interactive Communication Centre), in Tokyo in March 2002, and at DIS 2002 London in June. It was exhibited in May 2002 at BIG Torino, the International Biannual of Young Artists, Turin, Italy. It was exhibited and presented at Brandy Conference in Lucern, Switzerland and in October 2003 at Ryerson University, Media Image School, Toronto, F+R Hugs received the Ciberart 2004 Award for Best Artistic Project at Ciberart Festival and Conference, Challenges for a Ubiquitous Identity, Bilbao, Spain, in April 2004.